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Doklady Akademii Nauk SSSR (Novaya Seriya), Vol LXIV, No 3, 1949.

USSR STUDY ON THE EFFECT OF PRELIMINARY DARKEWING ON PHOTOSYNTHESIS IN HIGHER AND LOWER AQUATIC PLANTS

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Presented by Acad N. A. Maksimov, 30 September 1948 Bubmitted for publication 29 November 1948

Differences in photosynthesis exhibited by various species of plants and plants at various stages of phylogenetic development have been studied extensively (2, 4, 5, and 7). Having noticed the connection between the magnitude of photosynthesis and the rate of growth in various species of trees, V. N. Lyubimenko assumed that there is a definite correlation between the activity of plastids and that of the respiratory organs, and that this correlation extends into the sphere of intermediary metabolism (4). Similar views were expressed by S. P. Kostychev and S. V. Soldatenkov (3).

In launching my investigation, I was guided by the assumption that in the course of evolution, physiological processes must undergo modification as such and also iinsofarr as their interrelationship is concerned. It seemed to me that there must have been a gradual reduction of the relative extent of processes taking place in the dark and an increasing prevalence of photochemical reactions, 'similar to the development which takes place when a plant turns green. This induced a comparison of characteristics of the photochemical reaction under the influence of external factors, in this case darkening before the experiment, as a method of clarifying the underlying relationships.

The plants for investigation were selected with the view of having representatives of various systematic groups which are removed from each other as far as possible. Aquatic plants were chosen, because an ecologically similar material could be obtained in this manner.

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A higher and a lower plant or two representatives of the same group were tested simultaneously. The experiments were carried out in tap weter at a constant p<sub>H</sub> (approximately 6.0). The oxygen content of the water was determined by Winkler's method. The experimental setup has been described in detail in a previous communication (1). In the experiments mentioned below, two specimens of each species of plant were exposed to the light of a 300-two specimens of each species of plant were exposed to the light of a 300-watt lamp placed at a distance of 25-30 centimeters and switched on in the evening, while two other specimens of the same species were kept nearby, evening, while two other specimens of the same species were kept nearby, of the photosynthesis was tested at two intensities of illumination, 14,000 meter-candles and 1,500 meter-candles. The results of the experiments in question are listed in the appended table.

It can be seen that the intensity of photosynthesis is higher in all cases after darkening than after illumination. While in the case of the higher plants, the amount of photosynthesis is only slightly lowered by the strong illumination and comprises 88 percent of that shown by the darkened strong illumination and comprises to 52 percent in the case of algae. Plant, the corresponding ratio amounts to 52 percent in the case of algae. With the weaker illumination, the photosynthesis of higher plants is found to be lowered to 86 percent in the case of the higher plants and to 57 percent in the case of algae, as a result of previous exposure to light for 12 hours.

One may note the higher total intensity of photosynthesis shown by algae as compared with flowering aquatic plants. Chara is the only exception, but the specimens of that plant were in an inferior condition. This specific difference in the identical medium has been ascribed to internal factors involving accumulation and utilization of assimilated products (3). Algae threads, as distinguished from the shoots of flowering plants, do not provide any drainage from assimilating cells, so that the products of assimilation formed in these cells during periods of illumination accumulate there, inhibiting further photosynthesis.

This explanation does not cover all experimental data, however. Chara and Amblistegium riparium, notwithstanding the fact that their structure consists of leaves and stalks, react to darkening by an increase in photosynthesis amounting to 88 percent, while leaves of pond weed (Potamogeton) which had been detached from their stalks show, under identical conditions, an increase of only 5 percent. Apparently the specific difference shown by the two systematic groups investigated here is caused by something more complex than mere anatomical and morphological difference. M. N. Chrelashvili (6) has shown that accumulation of carbohydrates in the leaves has different effects on photosynthesis, depending on the nature of the substance; which are accumulated and also on the general nature of the carbohydrate metabolism. He demonstrated this by comparing the behavior of plants storing sugar with those which accumulate starch and those of the intermediate type. It is obvious that the respective enzyme mechanisms also play an important part in establishing the differences referred to.

We are planning experiments with both groups of plants that will involve a study of the effect of artificial changes in the carbohydrate content and carbohydrate balance on the amount of photosynthesis.

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Effect of Light Regimen on Photosynthesis

Photosynthesis (in mg  $\theta_2$  per hour per  $\theta$ .1 g. of dry weight) at the Intensity of Illumination

	hil, <b>High, After</b>		Photosynthesis in Specimens Exposed to Light (expressed in \$	Low, After iter	
•	Exposure to Light	Darkening	of effect in dark- ened plants)	Exposure to Light	Darkening
Lower plants					
Spirogyra sp.	2.41	4.33	56	-	-
Rhyzoclonium hieroglyphicum	0.87	2.48	35	0.05	0.41
Hydrodictyon reticulatum	2.89	4.94	58	0.18	0.43
Vaucheria sp.	0.86	1.48	58	0.	0.13
Chara fragilis	0.16	0.28	57	-	-
n 11	0.08	0.16	50	-	.=
Amblistegium riparium	1.87	3.51	53	-	-
Higher plants			:		
Elodea canadensis	0.94	1.10	85	0.22	0.29
Ceratophyllum cemersum	1.02	1.14	89	-	-
Potamogeton praelongus	0.94	0.99	95	0.37	0.41
Potamogeton praelongus	ô <b>.</b> 86	0.84	95	=	<i>=</i>
Hottonia   palustris	0.53	0.62	85	-	-
Callitriche verna	0.87	1.15	76	-	-

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